The Future of Machine Building is NOW!

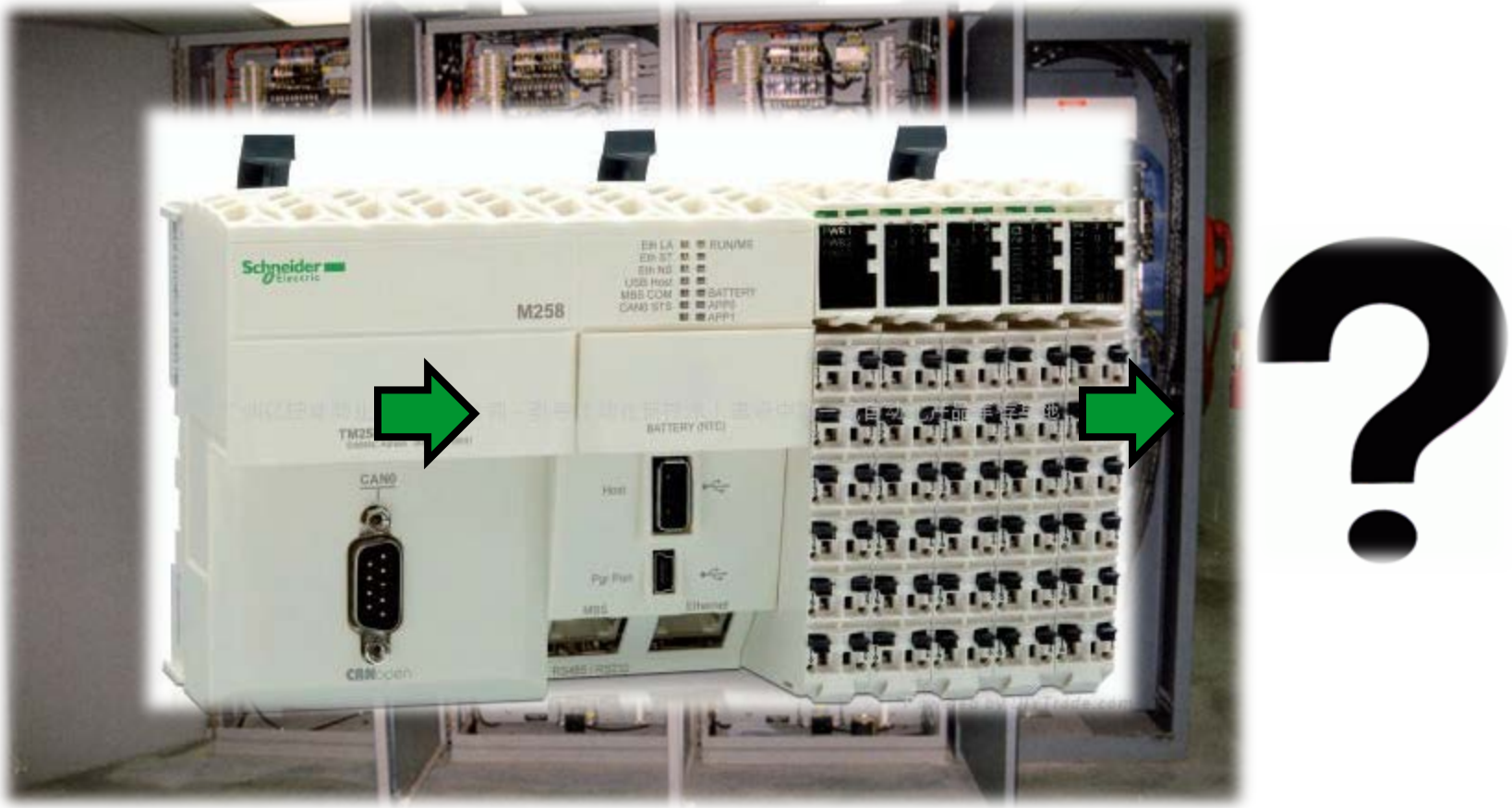
Ed Sandlin, Ashish Patwardhan & Alec Grainger
Schneider Electric
Industry NOW Express

Agenda

1. Simplicity
2. Remote monitoring
3. Energy efficiency
4. MachineStruxure

The Mobile Phone Evolution

Machine Control Evolution



The Future of Machines…

Integrated Automation

1900's

Now

Integrated Automation Defined

- "The convergence of previously distinct automation functions… An integrated platform uses one programming environment to handle all required functions"
  – Aaron Hand, Control Design and Industrial Networking

- More complete, sophisticated and flexible software environments

- Greater hardware flexibility and integration in machine control

- Simplified and more readily accessible physical machine configuration

Integrated Automation

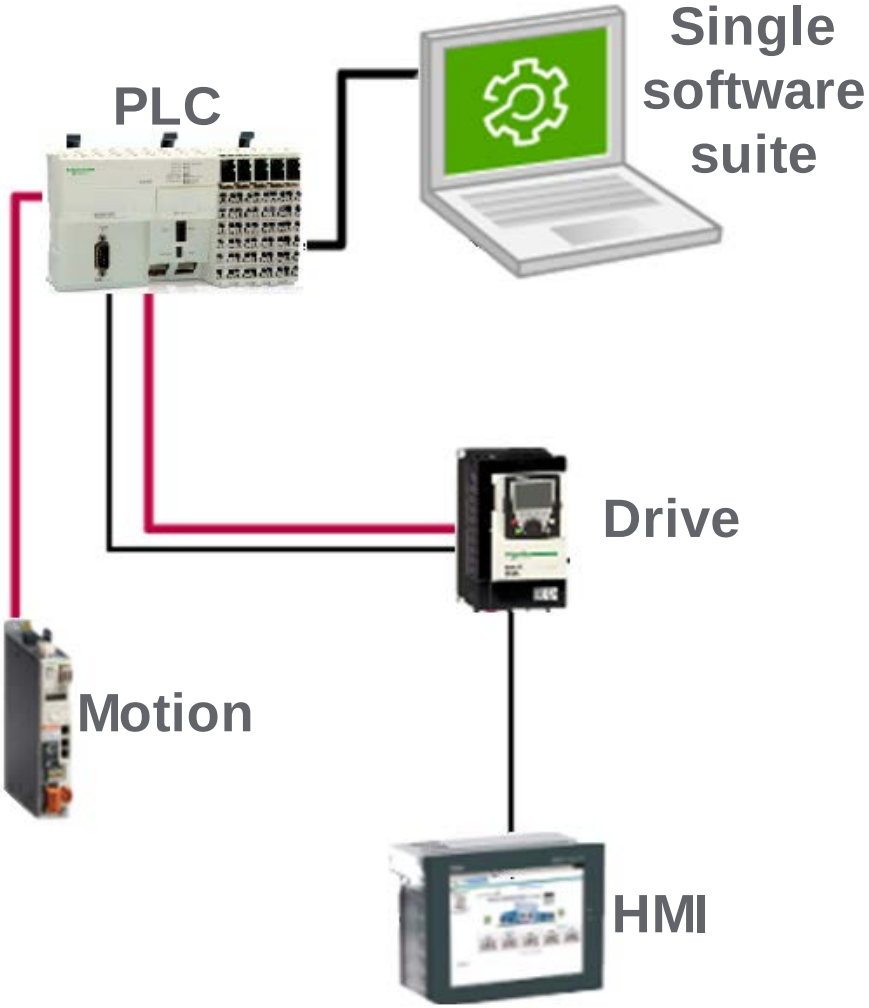
Then

Multiple software suites

Prop. Cable

I / O

Now



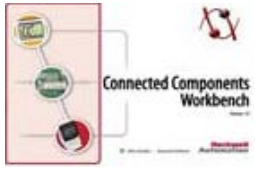
Software

SIEMENS

TIA Portal

Rockwell Automation

CCW Workbench



OMRON

CX-One

CX-One

Schneider Electric

SoMachine

B&R

Automation Studio

BECKHOFF

TwinCat 2 & 3

MITSUBISHI ELECTRIC

MELSOFT

One Software: SoMachine

With SoMachine, you can develop and maintain the complete application in a single software environment including control, motion, drives, HMI, sensors, application libraries and network automation functions.

1

software
One software for controllers, HMI and remote devices

download
Transfer the entire machine program in a single step

connection
Connect your cable just once and the program is downloaded to the entire machine

project file
Create and maintain a single project file

Hardware Flexibility

Drive

HMI-PLC

Integrated Motor

Drive-PLC

“Int… could overtake standalone systems”

…HMI-PLCs will gain in popularity and drop in price”

Architecture Simplification

What is Needed?

1. Training
2. Programming
3. Wiring
4. 3rd party components
5. Testing

The Fix

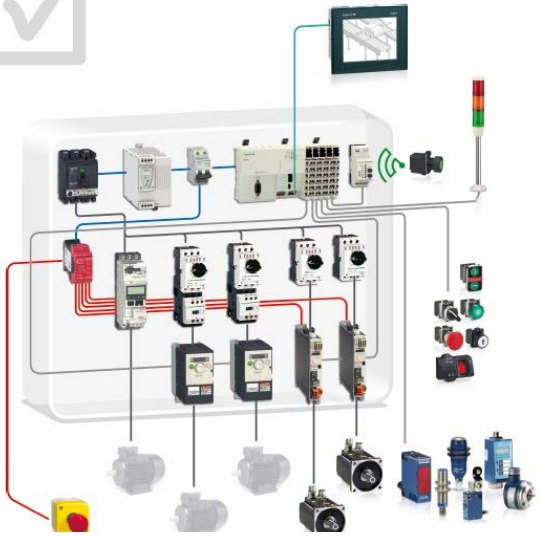
1. Training manuals
2. Sample code & templates
3. Sample architectures
4. White papers
5. Simulation mode

Solutions for Machines

Save up to 50% in design time

Ready-to-use architectures for optimum results

Predetermined equipment lists



Tested

- Applications tested by our experts to ensure that they work in all possible configurations

Validated

- Fully functional compatibility of devices

Documented

- Full user manual containing all the required information for installation and assembly, including CAD and wiring diagrams

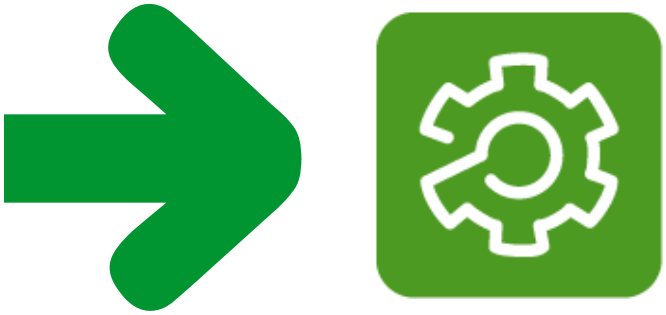
System user guide

Customizable Machines

Value

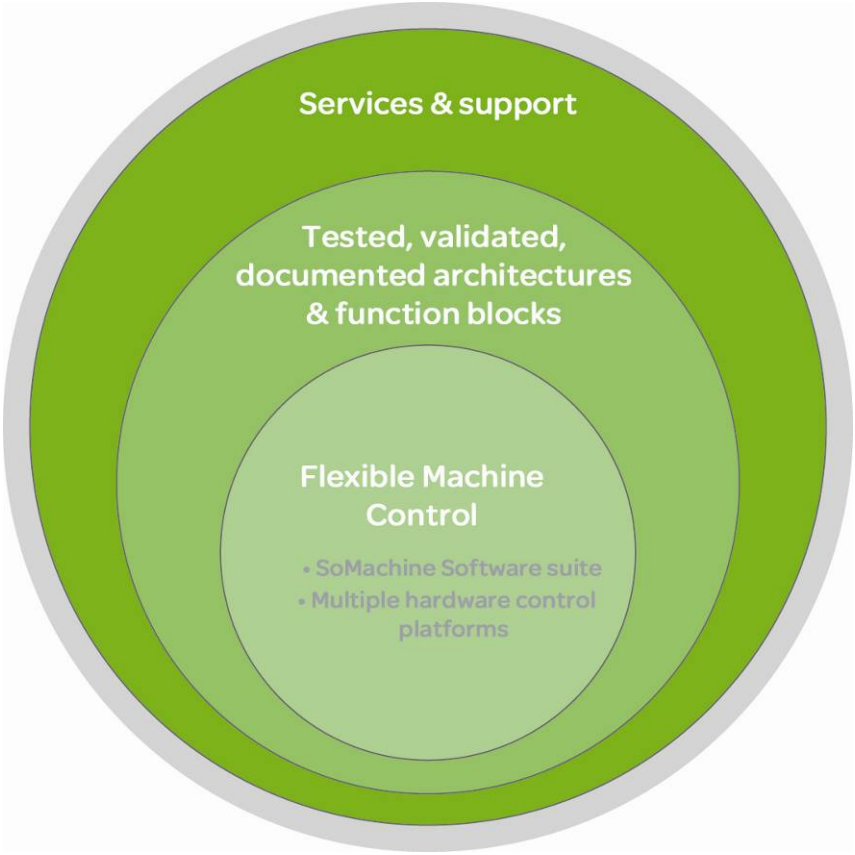
- Flexibility
- Scalability
- Repeatability

Innovative Controls Engineering



What Does Simplicity Mean?

With MachineStruxure solutions, you can answer your customers' challenges and help them remove complexity from their businesses.


Services & support
Tested, validated, documented architectures & function blocks
Flexible Machine Control
• SoMachine Software suite
• Multiple hardware control platforms

- **Reduce time to market**
- **Save 50% in control design time**
- **100% flexibility & optimization of your machines**

You remember the Bass Model…

- Ability to forecast future sales and the rate of adoption
- Bass Model

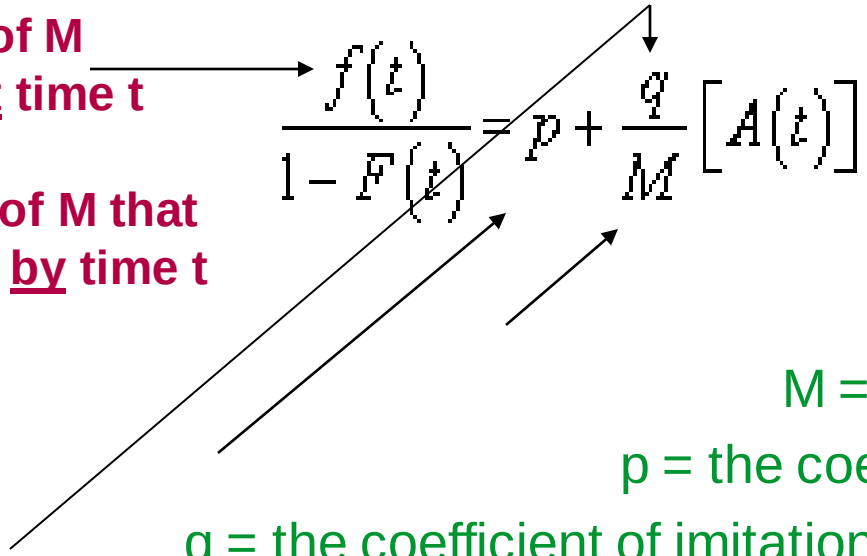
$$\frac{f(t)}{1-F(t)} = p + \frac{q}{M}\left[A(t)\right]$$

Frank Bass
1926-2006

Bass Model

f(t) = portion of M that adopts <u>at</u> time t

F(t) = portion of M that have adopted <u>by</u> time t



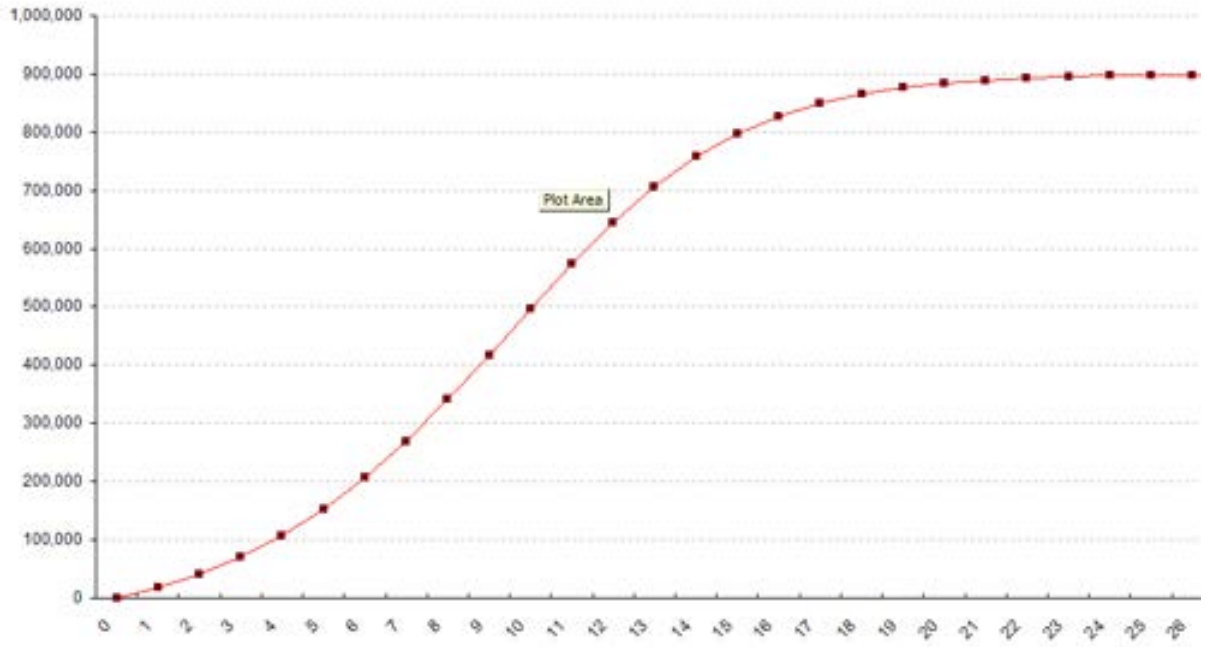
Total Adoptions at Time t

M = the potential market

p = the coefficient of innovation

q = the coefficient of imitation

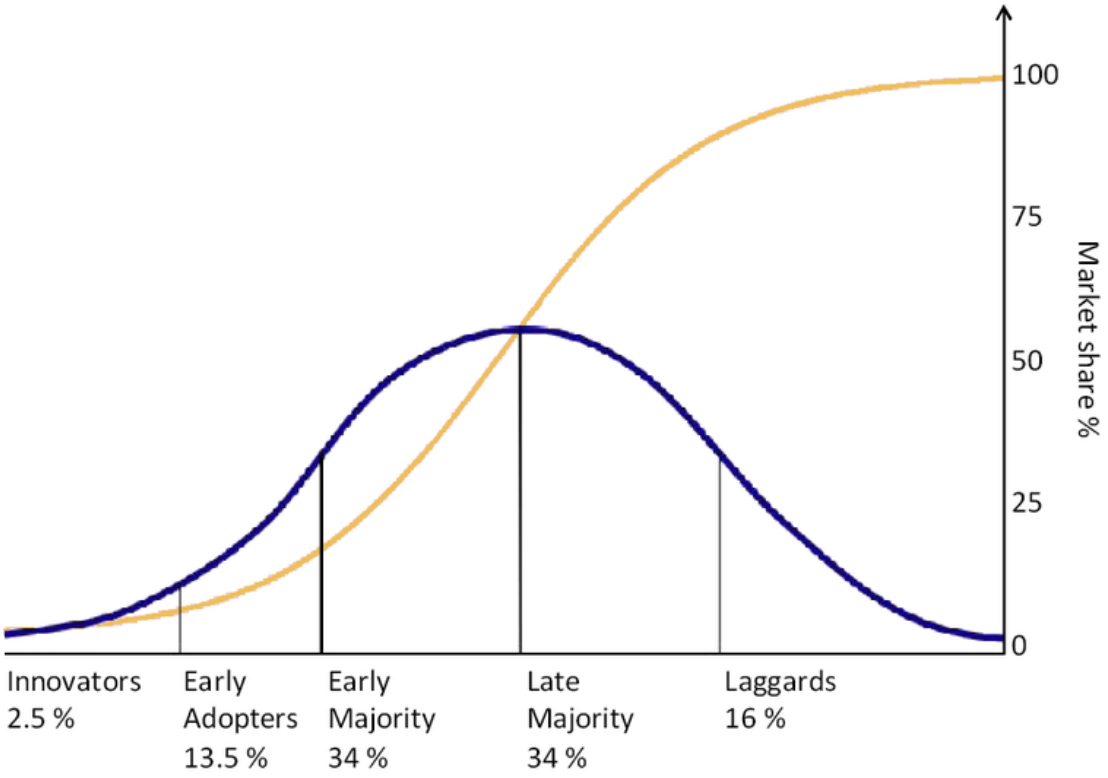
Bass Model Generalization



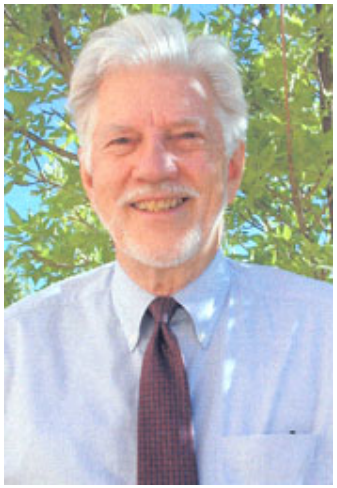
The “S Curve” of change

Rogers' Diffusion of Innovation

- Different consumers make it through the steps at different speeds

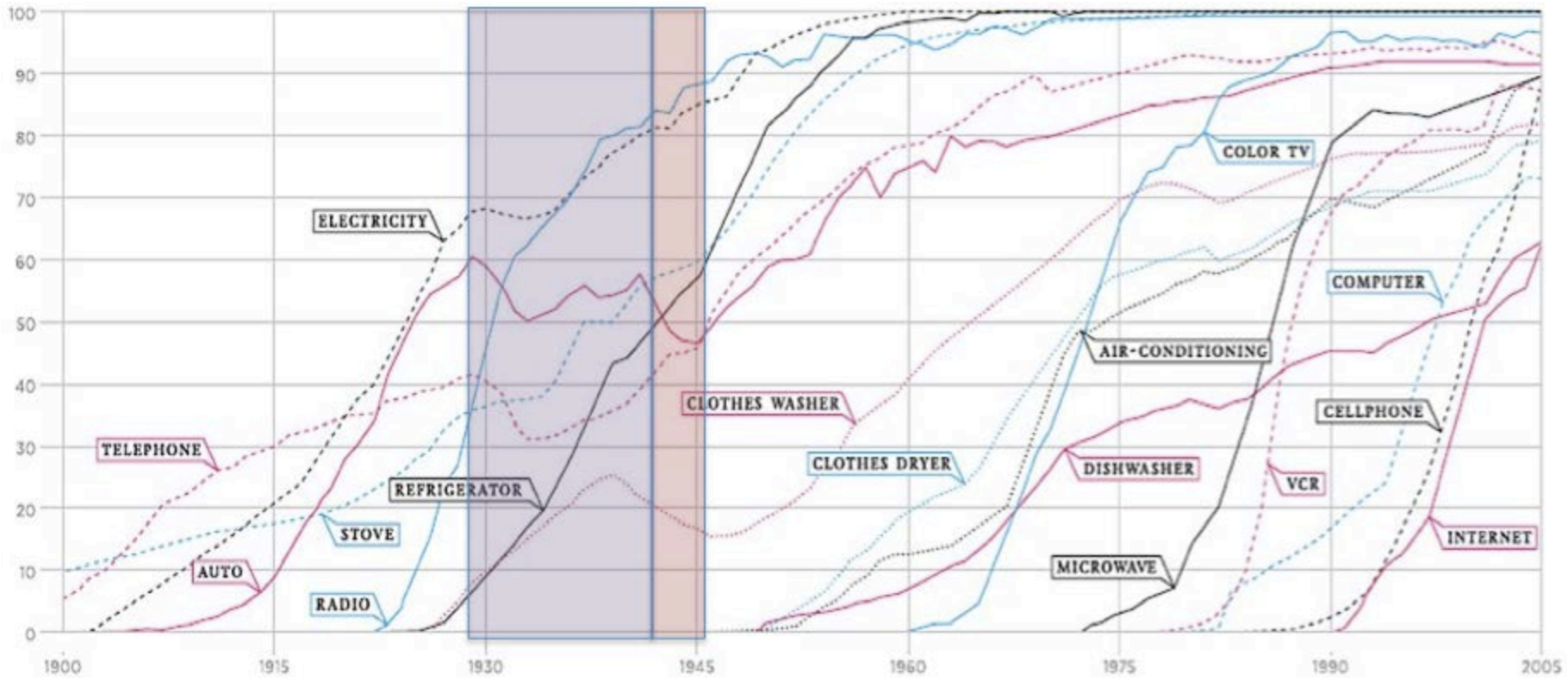


Sales over time



Everett Rogers
1931-2004

Technology Adoption Curves



Remote Interaction: Internet

- NetMeeting / Skype / Google Hangouts / TeamViewer / Dropbox

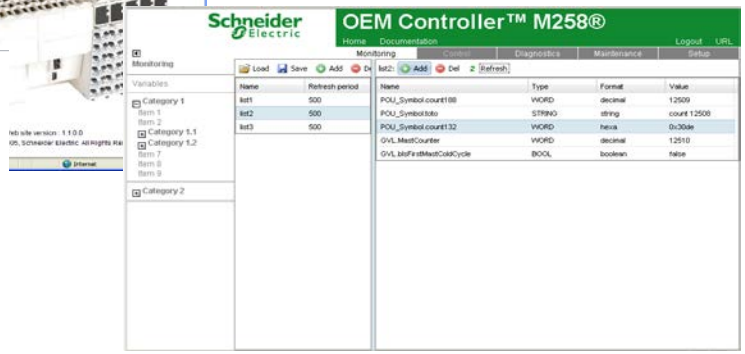
TeamViewer

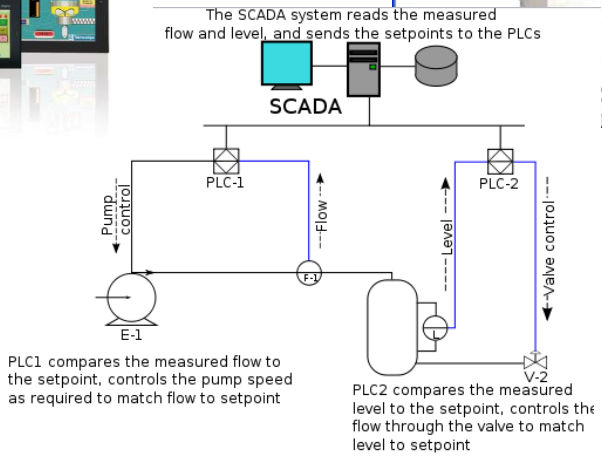
skype™

Hangouts!

Remote Interaction: Machines

- Machine: recipe management, trouble shooting, remote monitoring
- Shop floor to office to service connectivity
- SCADA / Web servers/ Web Gate / FTP servers/ USB keys…



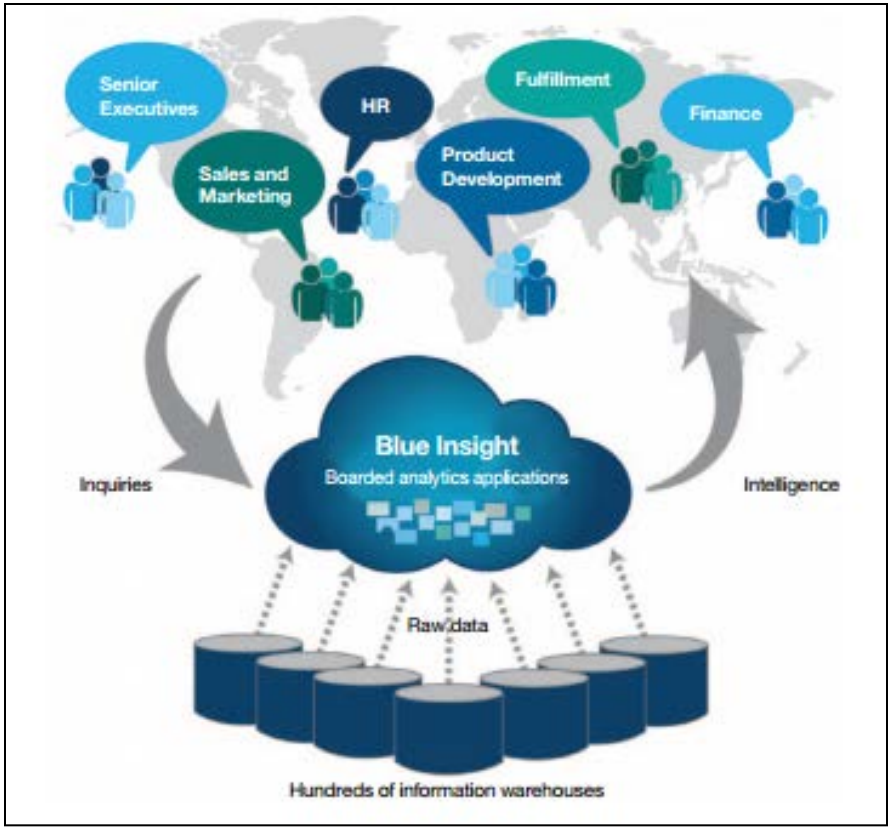

The SCADA system reads the measured flow and level, and sends the setpoints to the PLCs
SCADA
PLC-1
PLC-2
Pump control
Flow
Level
Valve control
E-1
F-1
V-2
PLC1 compares the measured flow to the setpoint, controls the pump speed as required to match flow to setpoint
PLC2 compares the measured level to the setpoint, controls the flow through the valve to match level to setpoint

Future? The Cloud – Engagement

Engaging with customers, partners, and employees

Microsoft / IBM / Oracle / Salesforce.com

Ford Focus connecting onboard WiFi with ATT



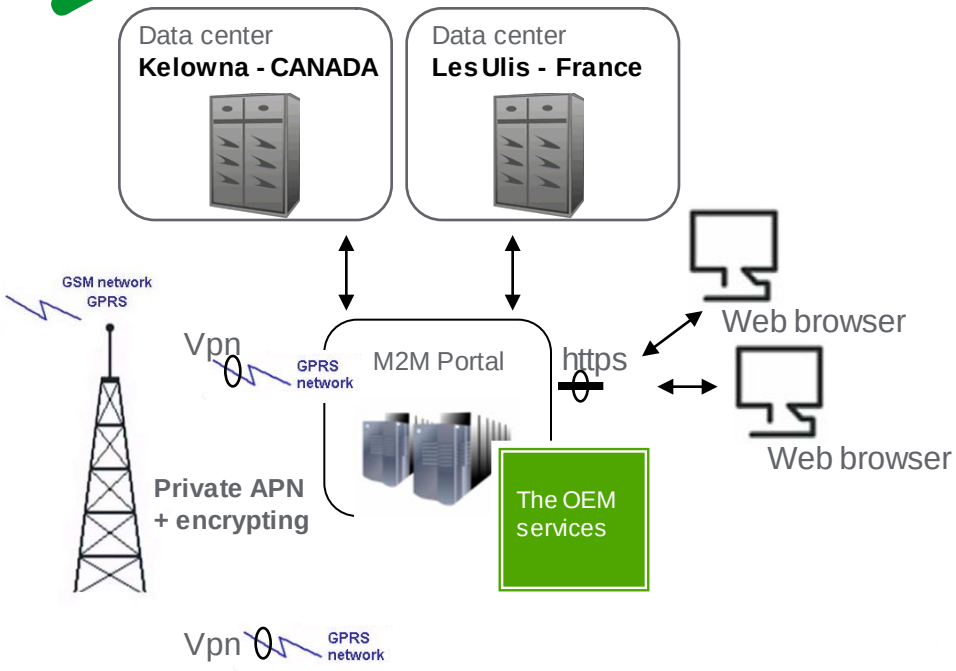
The Cloud for Machine Builders: M2M

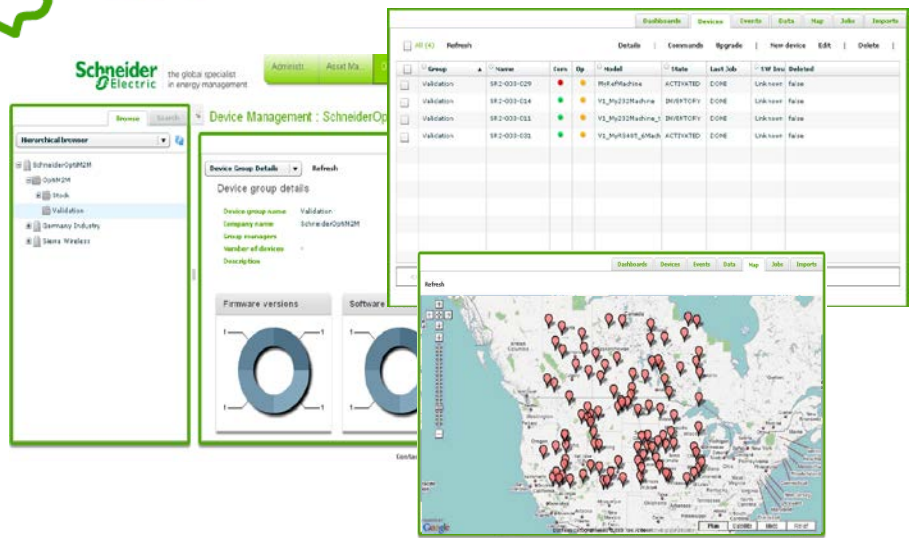
Engaging with machines and business

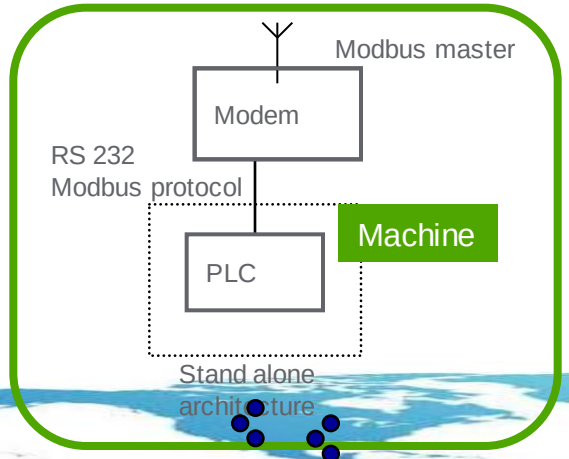
- Automation specialists offering dedicated M2M services
  - GE: GE Remote Condition Monitoring Center
  - HMS: RemoteCom
  - ETIC
  - Schneider Electric
- Large OEM companies developing their own solution with equivalent features
  - Daikin
  - Carrier
- M2M companies offering Cloud-based services
  - Ewon: Talk2M
  - M2MDatacorp
  - Ei3

OptiM2M – How it works

Architectures & infrastructure

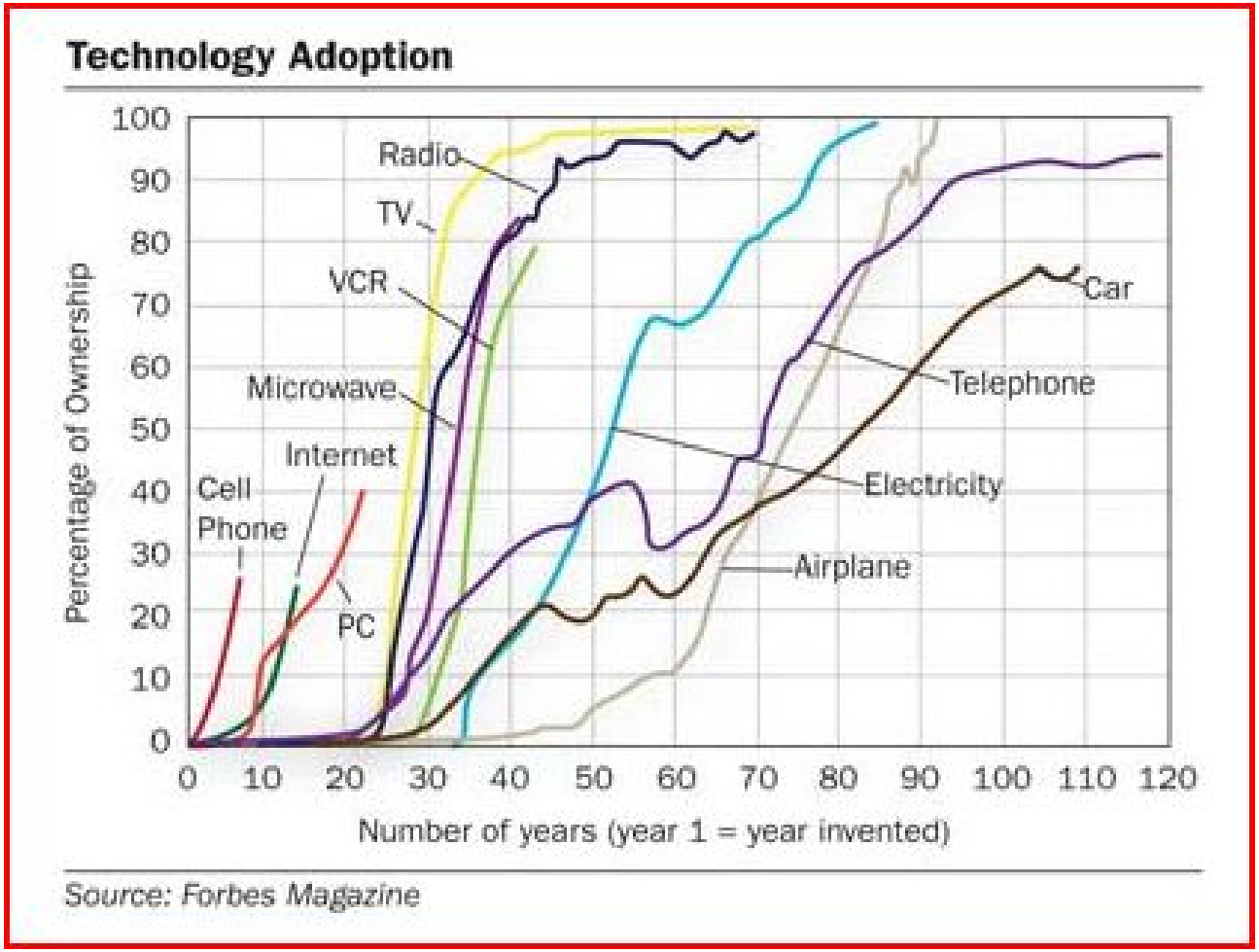






Cell Phone Revolution

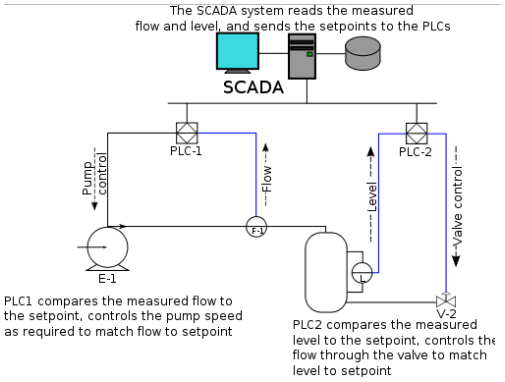
Connecting with people



Cell Phones for Machine Builders

Connecting with machines / factories

SCADA / PLC / HMI / Software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Example: Aluma Tower

ALUMA TOWER COMPANY, INC.

Smartphone – Smart Devices Revolution

Knowledge, empowerment and connectivity

Apple / Samsung / Blackberry / LG / Google / Microsoft / Amazon / …

Smart Devices for Machine Builders

Knowledge, empowerment and connectivity

Selection Apps / Control Apps / HMI Web Gate Apps

Example: Palladium Technologies

The Future? NOW!

Consumer & Machine Building

Completely automated machines and robots

Rodney Brooks

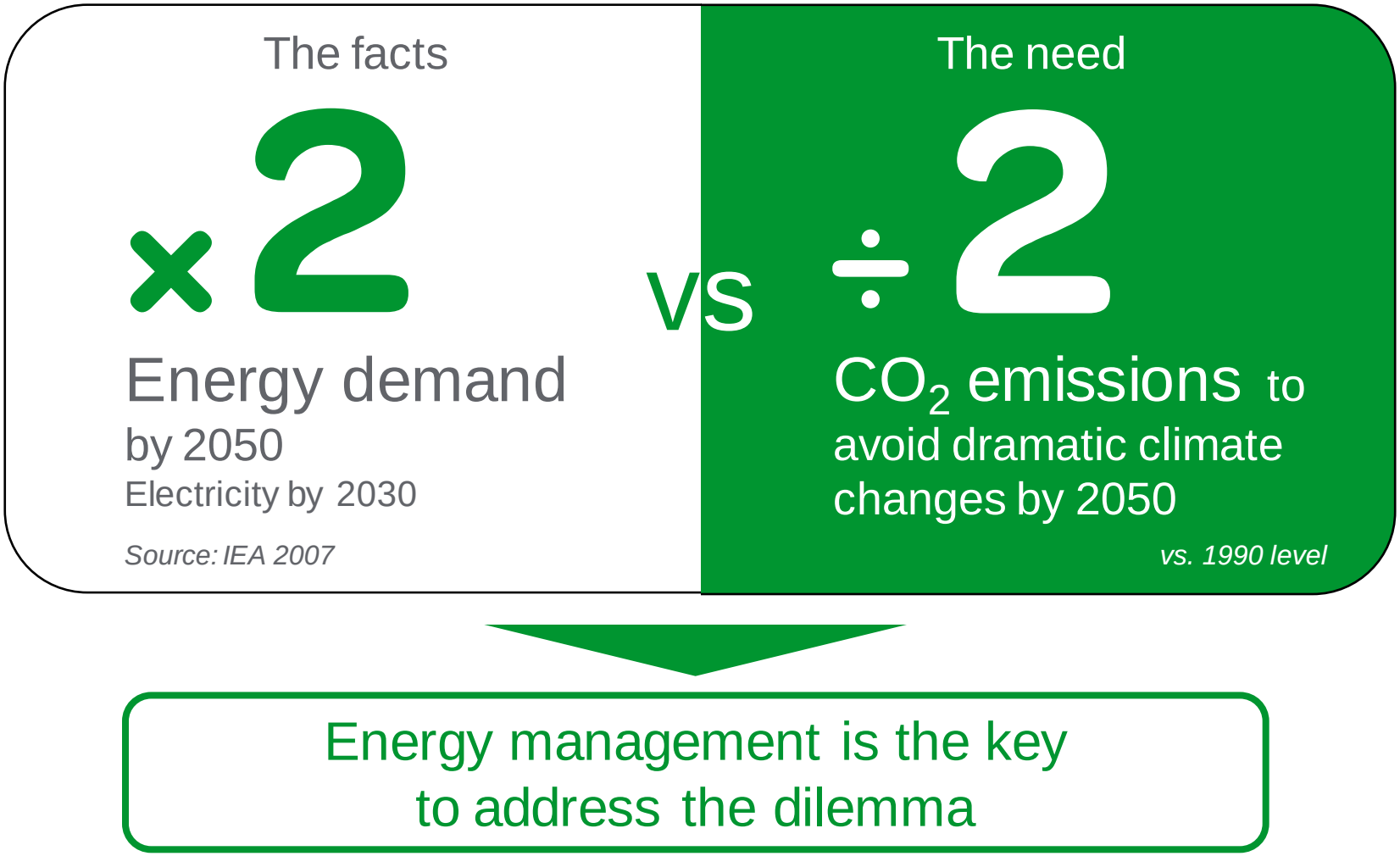
iRobot

rethink robotics

http://www.youtube.com/watch?v=rjPFqkFyrOY

Why Energy Optimization?

The Energy Dilemma



Recent Articles

The push to achieve reductions in energy consumption is a significant global trend

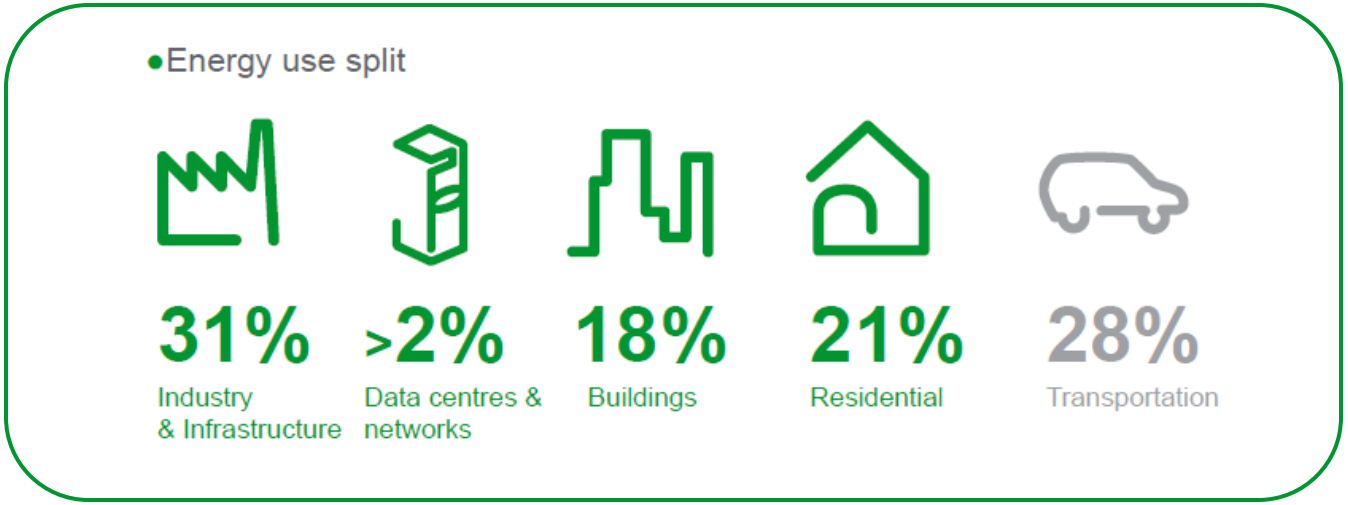
- **MGM Resorts Hits the Energy Efficiency Jackpot**
  - ***Design World*, SEP 2012**
- **Energy Management Strategy, Roadmap Needed?**
  - ***Automation World*, SEP 2012**
- **Don't Leave Energy Projects ROIs on the shelf**
  - ***ControlDesign,* MAY 2012**
- **Energy Efficiency: The Secret to Sustainable Machines**
  - ***Automation World*, MAR 2011**

Trends

- The focus for machine design is no longer simply maintaining acceptable production rates at an appropriate level of quality.
- Automation professionals are now deploying technologies in clever ways to improve the energy efficiency of their automated machinery.
- In fact, companies that endorse energy efficiency and sustainability in their thinking experience stronger loyalty from their customers, produce better quality machines with improved machine performance, and find more opportunities for new business even in a tough economic environment.

Source: *Automation World*

Energy Efficiency as a Source of Energy

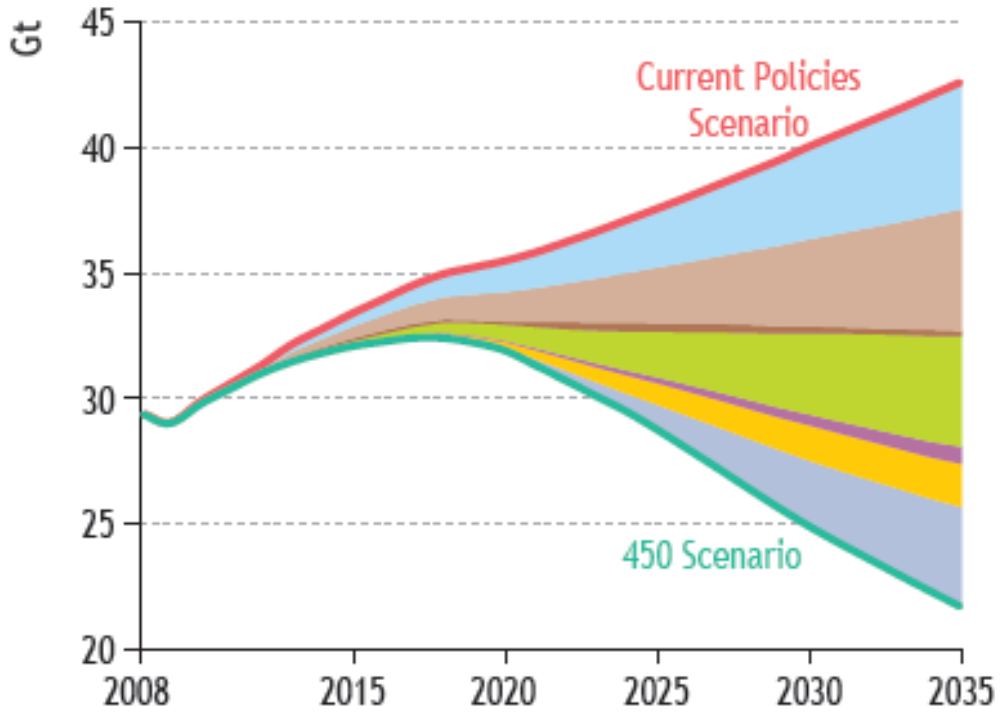


The Power of a Combined Solution

Greater efficiency, smarter grid, and cleaner generation

- Over 50% of CO_2 emission abatement will come from end user efficiency

World energy-related CO_2 emissions abatement



	Abatement		
	2020	2030	2035
Efficiency	71%	49%	48%
End-use (direct)	*34%*	*24%*	*24%*
End-use (indirect)	*33%*	*23%*	*23%*
Power plants	*3%*	*2%*	*1%*
Renewables	18%	21%	21%
Biofuels	1%	3%	3%
Nuclear	7%	9%	8%
CCS	2%	17%	19%
Total (Gt CO_2)	3.5	15.1	20.9

Source: World Energy Outlook 2010, OECD / IEA

Energy Efficiency for Industry Has Already Started

Sustainability

Retail

Walmart
Save money. Live better.

Consumer Packaged Goods

MARS | Sustainability at our sites

• 3% year-over-year reduction in energy, water, and waste. We are committed to reducing our waste and use of non-sustainable energy and water.
• Sustainable in a generation. We are committed to a zero carbon footprint, zero impact in the use of water and zero waste to landfill at our sites by 2040.

Material Handling

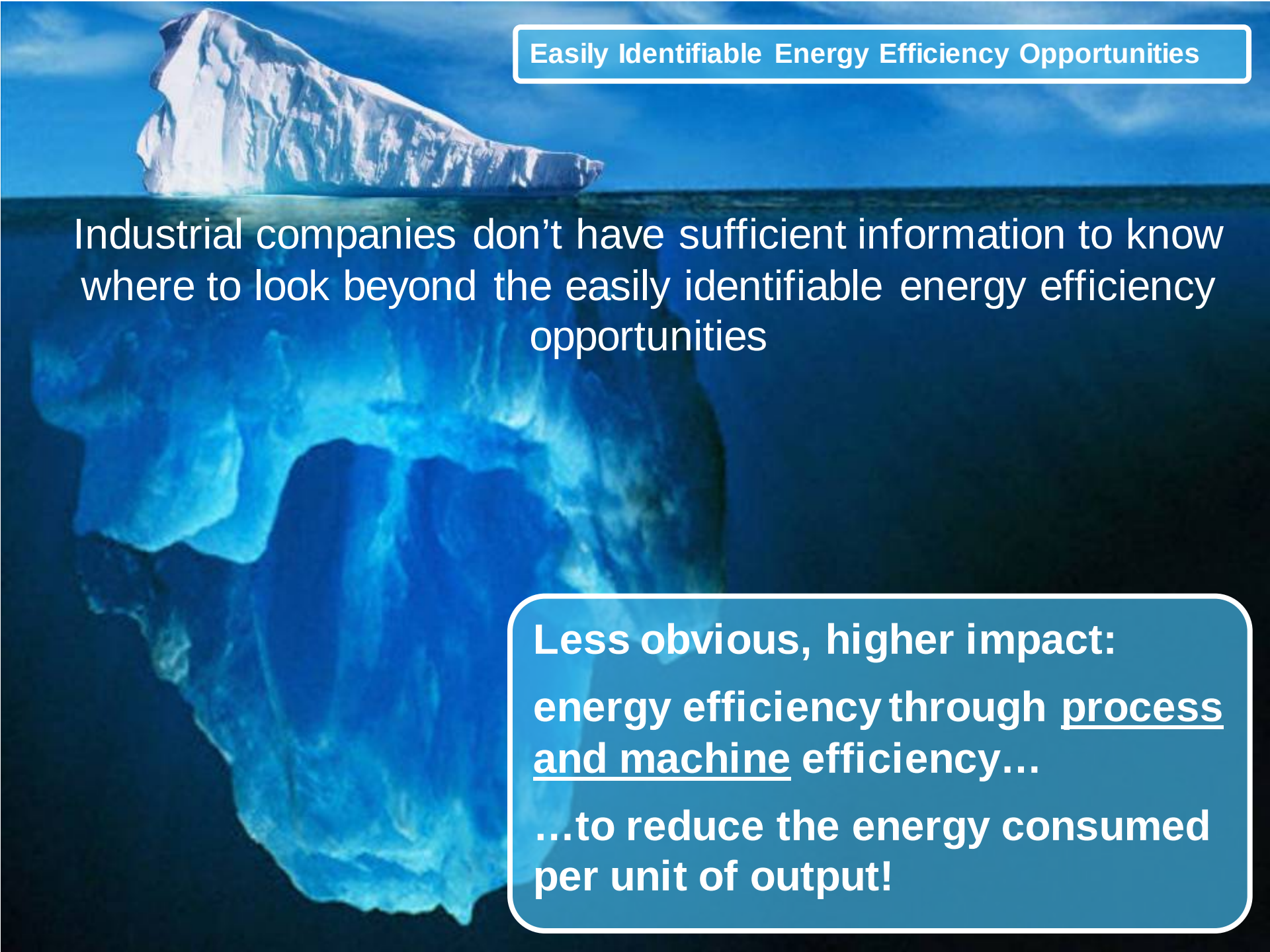
UPS Going Green

UPS has become the first major package delivery and logistics company to earn Gold Status certification from the Leadership in Energy and Environmental Design (LEED) along with an Energy Star certification for its corporate headquarters complex

Buildings

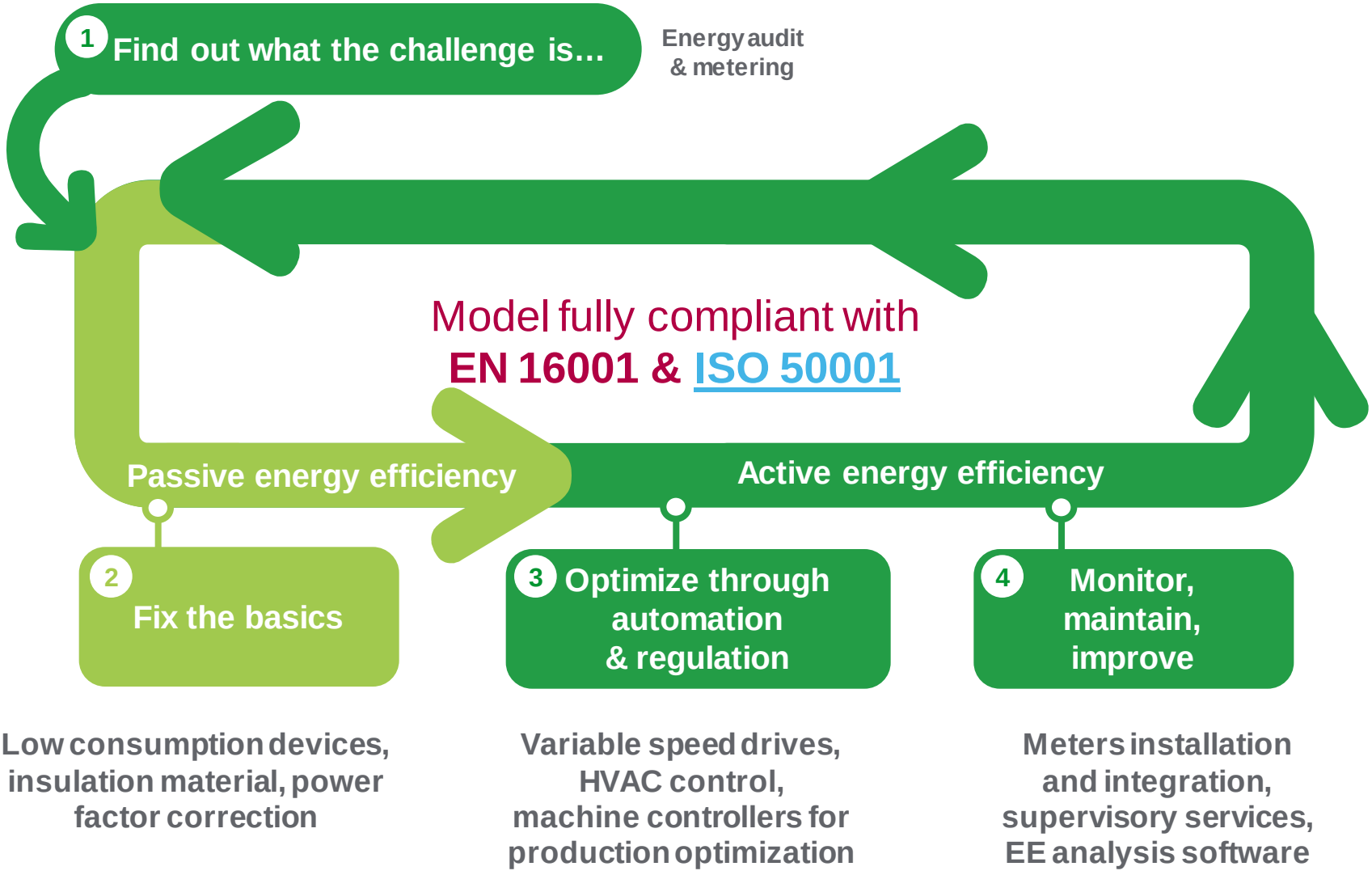
MGM GRAND

MGM Resorts Hits the Energy Efficiency Jackpot: In Las Vegas, one of the leading corporations in the "entertainment capital of the world" is staying true to the city's visionary history by anticipating the need for sustainable and energy-efficient structures well ahead of many of its competitors.


Easily Identifiable Energy Efficiency Opportunities
Industrial companies don't have sufficient information to know where to look beyond the easily identifiable energy efficiency opportunities
Less obvious, higher impact:
energy efficiency through process and machine efficiency…
…to reduce the energy consumed per unit of output!

Solving the Energy Equation

with a focus on energy efficiency


1 Find out what the challenge is…
Energy audit & metering
Model fully compliant with
EN 16001 & ISO 50001
Passive energy efficiency
Active energy efficiency
2 Fix the basics
3 Optimize through automation & regulation
4 Monitor, maintain, improve
Low consumption devices, insulation material, power factor correction
Variable speed drives, HVAC control, machine controllers for production optimization
Meters installation and integration, supervisory services, EE analysis software

Passive + Active EE solutions = Sustained Energy Savings

Why Improve Energy Efficiency in Machines?

- Energy efficiency is an increasing concern in the global strategy of your customers. By offering them machines that save energy you will have a definite advantage over the competition.

- MachineStruxure™ solutions help you design more energy efficient machines while increasing:
  - Machine performance
  - Machine attractiveness for end users

"Together with Schneider Electric we realized the new SP2 NG – an energy efficient machine, bringing tangible improvements to the end user in energy usage, in terms of consumed watts per manufactured unit, enabling up to 30% energy savings compared to traditional machines."

ACMA
Flowpack Division

End-users Have Already Shifted to “Green”

- Energy savings is now **the second criteria** considered when choosing a machine

- In 2011, **77%** of end users increased or maintained their investment towards “Green”

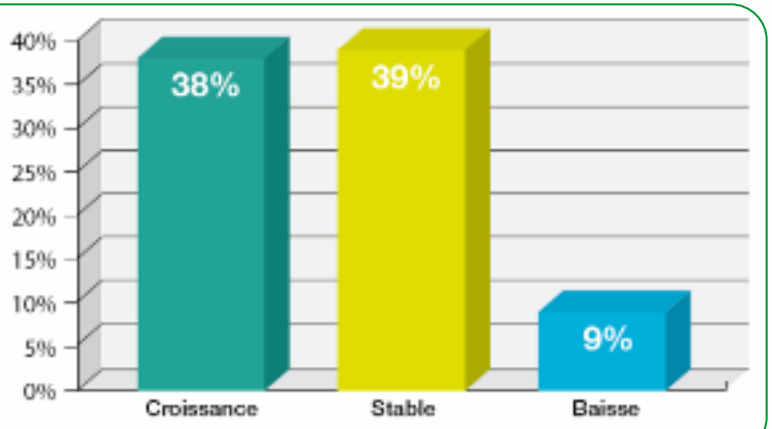
in 2007

1. Price
2. # of operators
3. Saving use of consumables
4. Packing material reduction
5. **Energy savings**

in 2011

1. Price
2. **Energy savings**
3. Saving use of consumables
4. # of operators
5. Packing material reduction

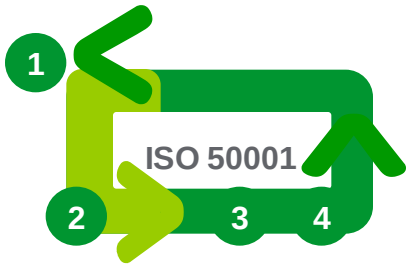
How is your investment in sustainable development evolving?



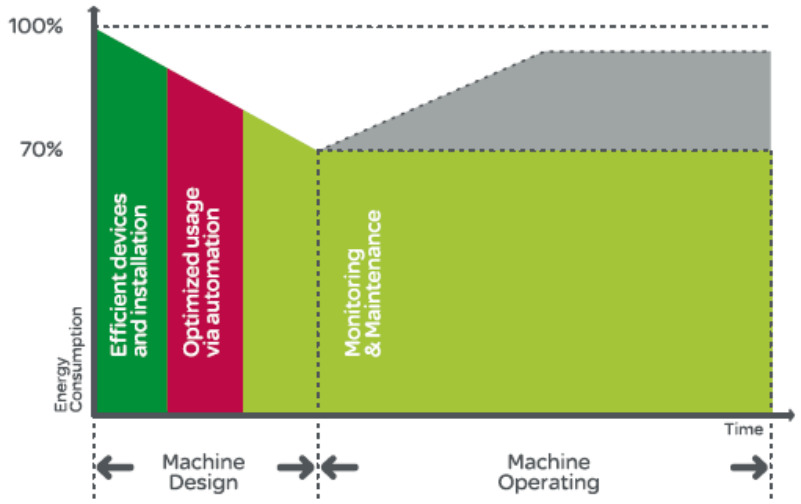
Europack-Euromanut (+300 enterprises in Packaging-Consumers Industry) Summer 2011

How to Boost Energy Efficiency in Machines

Machine Energy Optimization In Four Sustainability Steps



- Follow the 4 energy efficient principles adapted to the machine life cycle to support energy savings and obtain immediate results
- Make your machine an enabler for end user compliance to **EN 16001** & **ISO 50001** standards



Up to 8% per year is lost without monitoring and maintenance program

Up to 12% per year is lost without regulation and control systems

Machine Energy Optimization In Four Sustainability Steps

1- Audit your machine energy

Identify energy waste in your machine and recommend optimization solutions

2- Fix your machine basics

Select relevant motor optimizer motor control

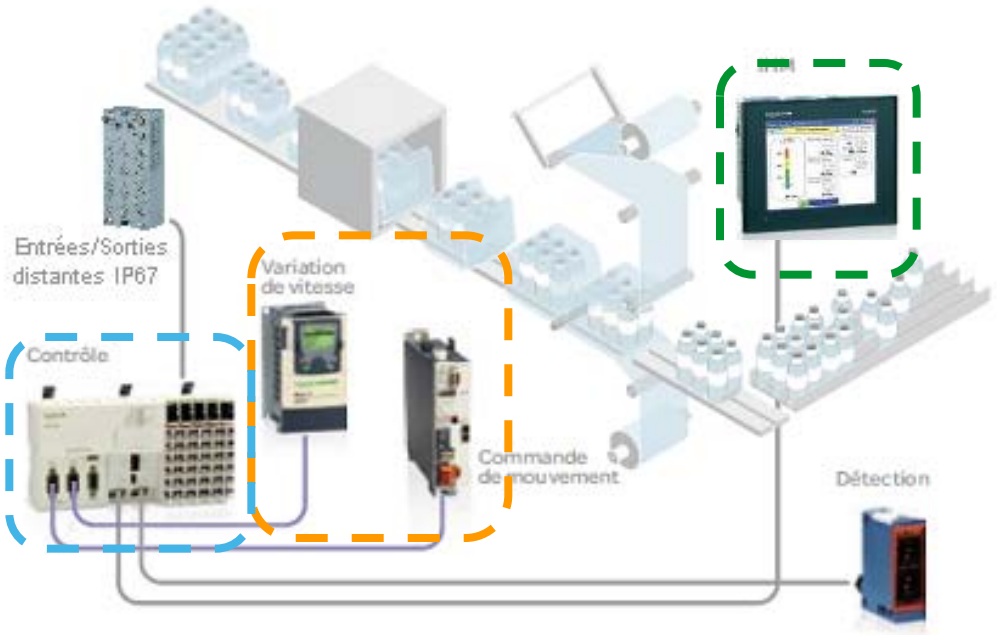
- → Use variable speed drives
- → Use Servo-drives and synchronous motors

3- Optimize your machine

Energy operating modes: high value mechanism with no additional hardware cost

- → Energy management functions in controllers and HMI
- → Energy optimization guidelines for machines in targeted applications (HVAC&R, packaging, conveying, hoisting, etc.)

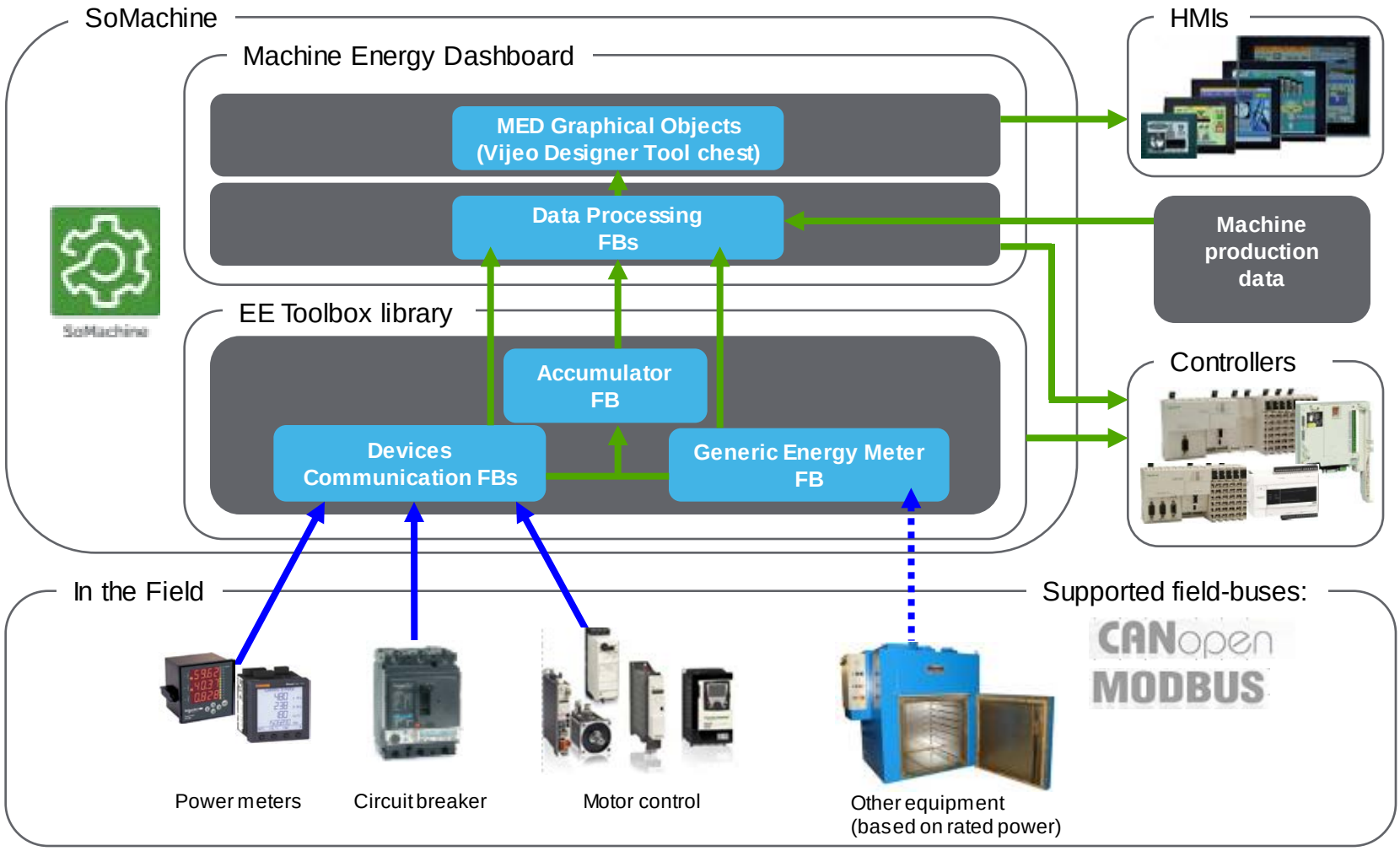
4- Monitor energy consumption



Focus on Energy Monitoring Libraries for Machines

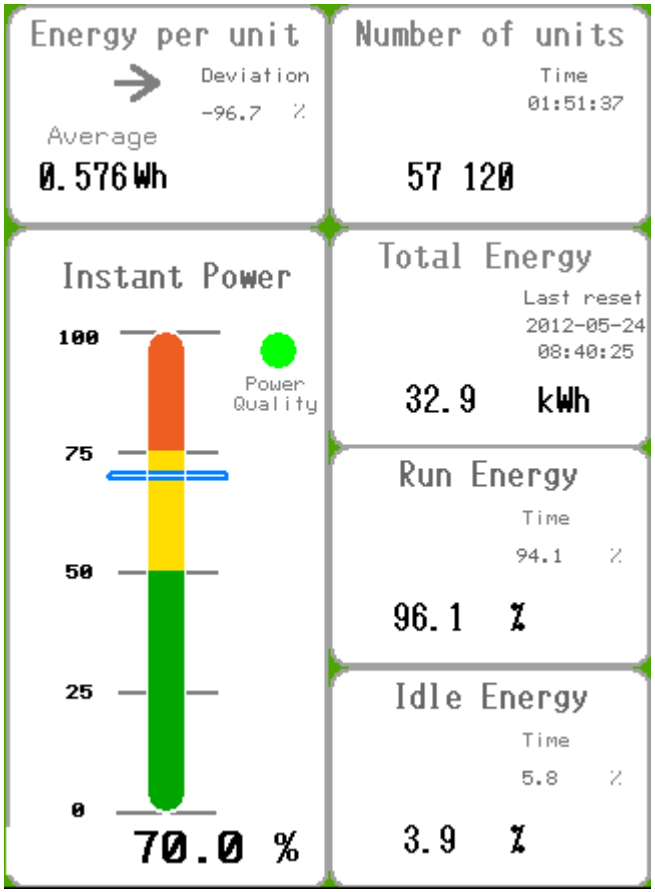
How does it work?

Libraries interactions:



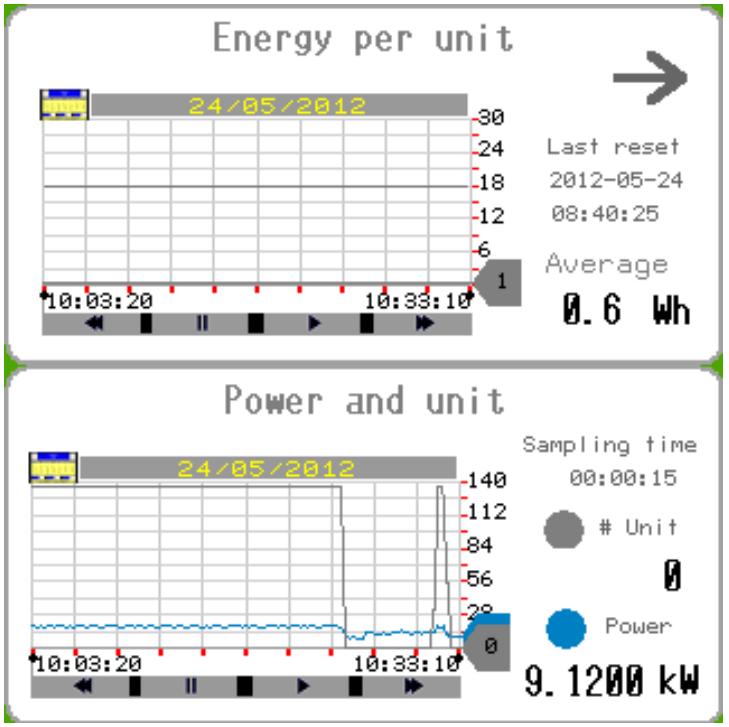
Machine Energy Dashboard - Overview

- Simple indicators for operator
  - Real power: Color ranges for quick detection of any deviation
  - Real energy:
    - Split by operating mode
    - Spent per unit produced
  - Peak alert
  - Trend indicator
  - Ready-to-use and fully customizable (units, thresholds, reset control, etc.)



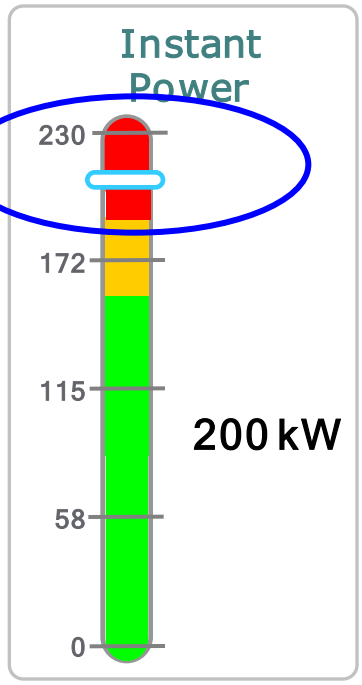
Machine Energy Dashboard - Overview

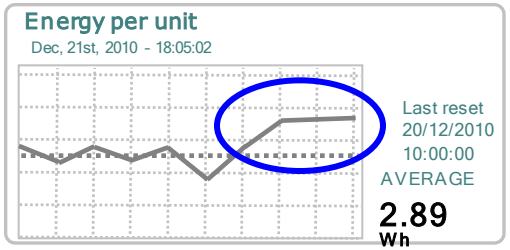
- Trend Information
  - Energy per unit
    1. Energy calculated per unit produced
    2. Average energy for total amount of units
    3. Energy per unit target (constant value)
    4. Energy per unit high limit - generates an alarm when reached
  - Power and unit
    1. Average power per sampling time (hours, minutes, etc.)
    2. Amount of units produced per sampling time

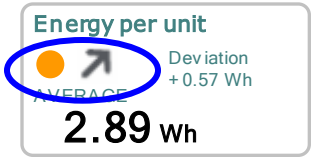


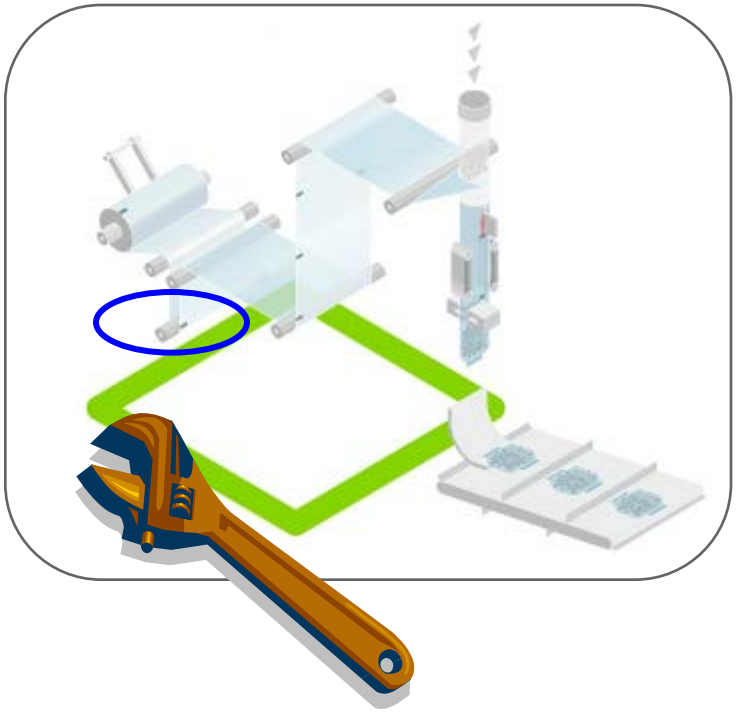
EE Monitoring: Improve Predictive Maintenance

→ Deviation to target often indicates equipment "pre-failure"









1 - Analyze over-consumption

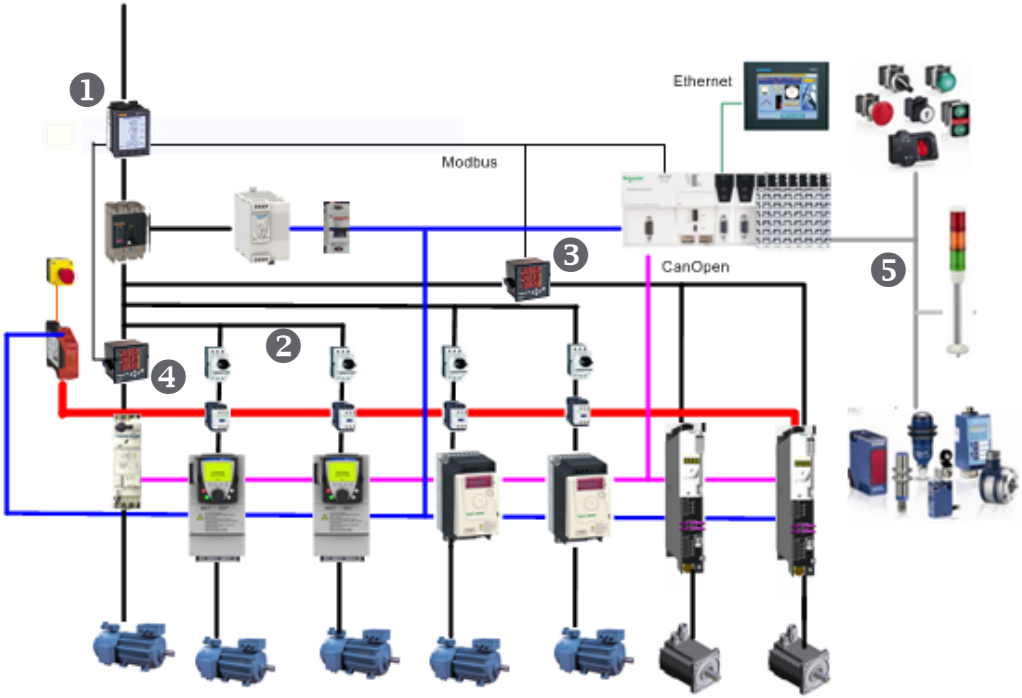
- Worn mechanical bearings
- Motor failure
- Electrical issue (insulation, power quality, etc.)
- Lack of lubricant
- Unexpected temperature increase
- Raw material properties change
- Dirty filters
- …

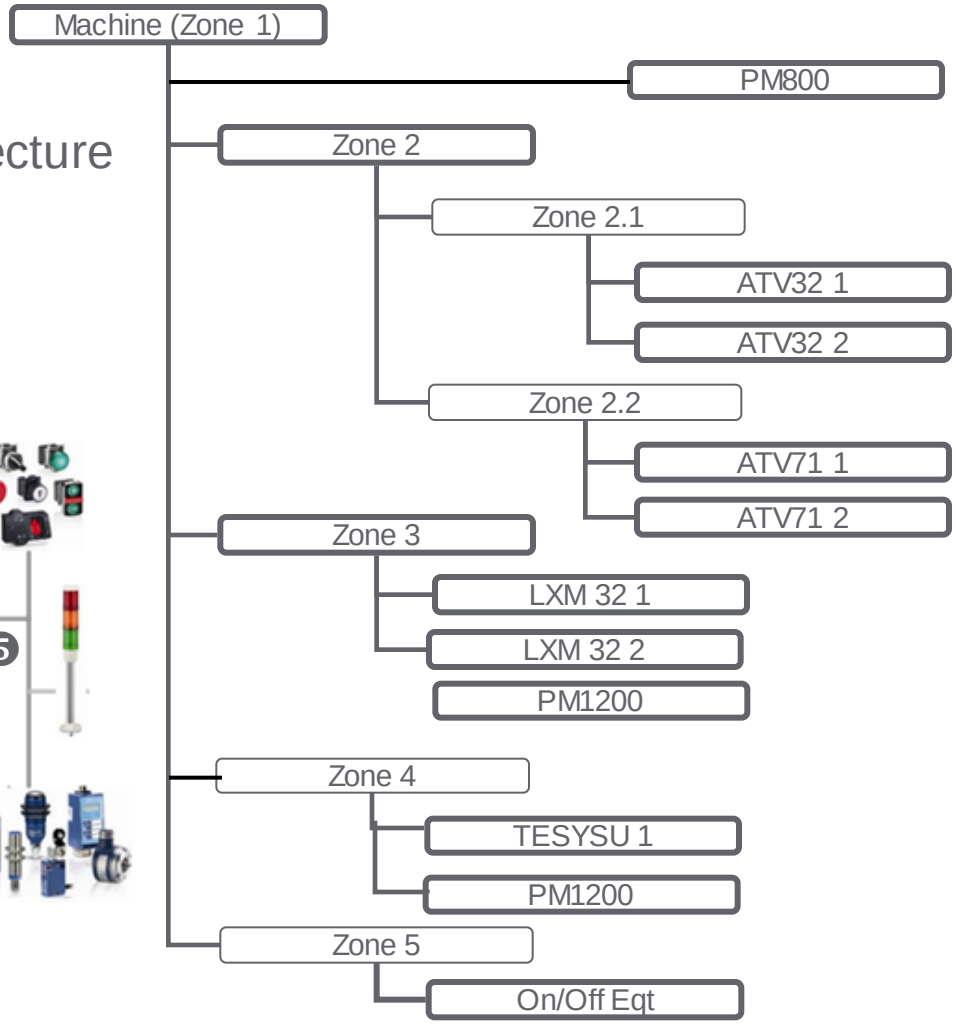
2 - Fix problem before serious issue occurs – limit impact on performance

EE Monitoring: Distributed Architectures

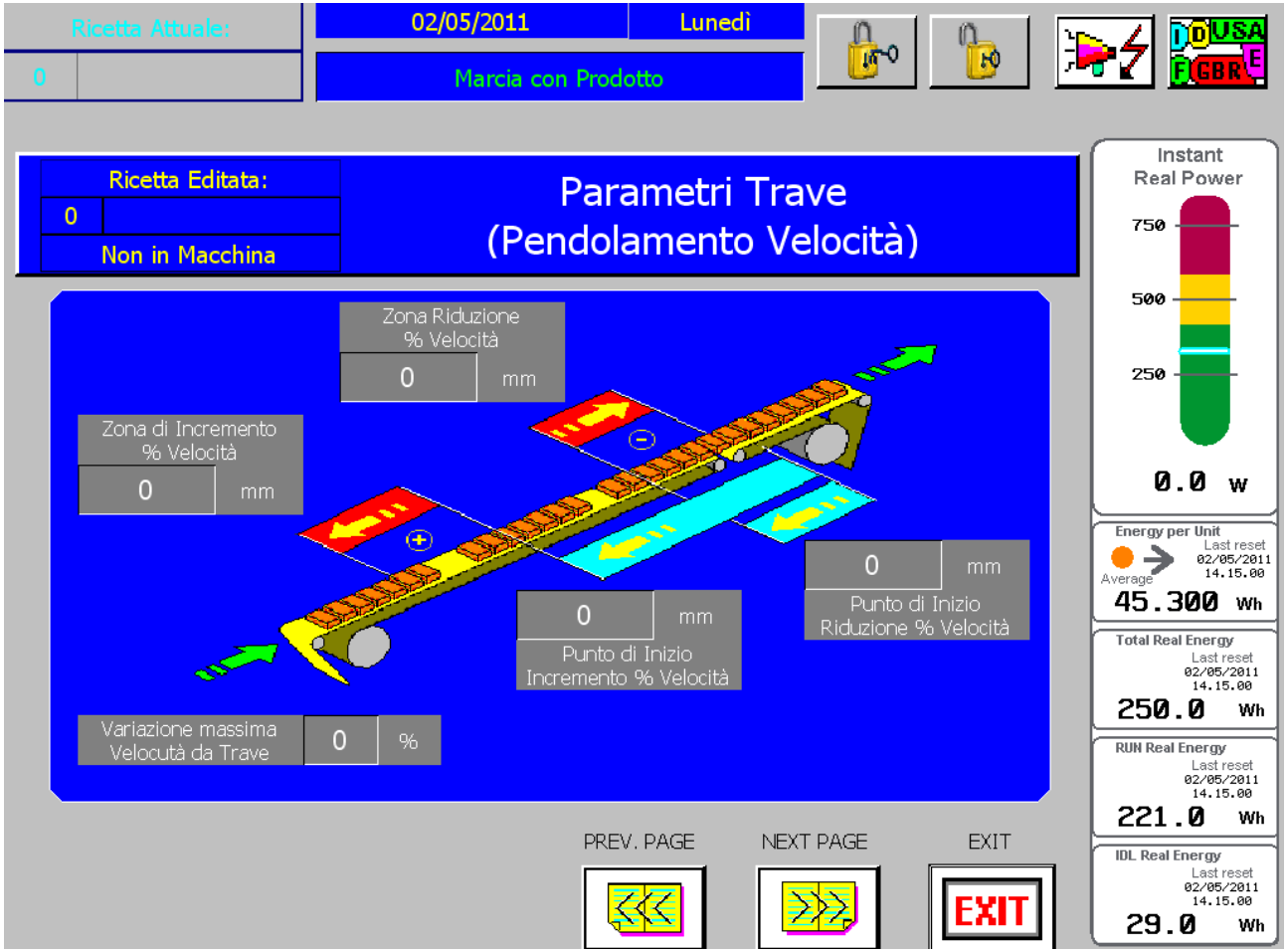
→ Example of distributed monitoring architecture

Modbus / CANopen with M258

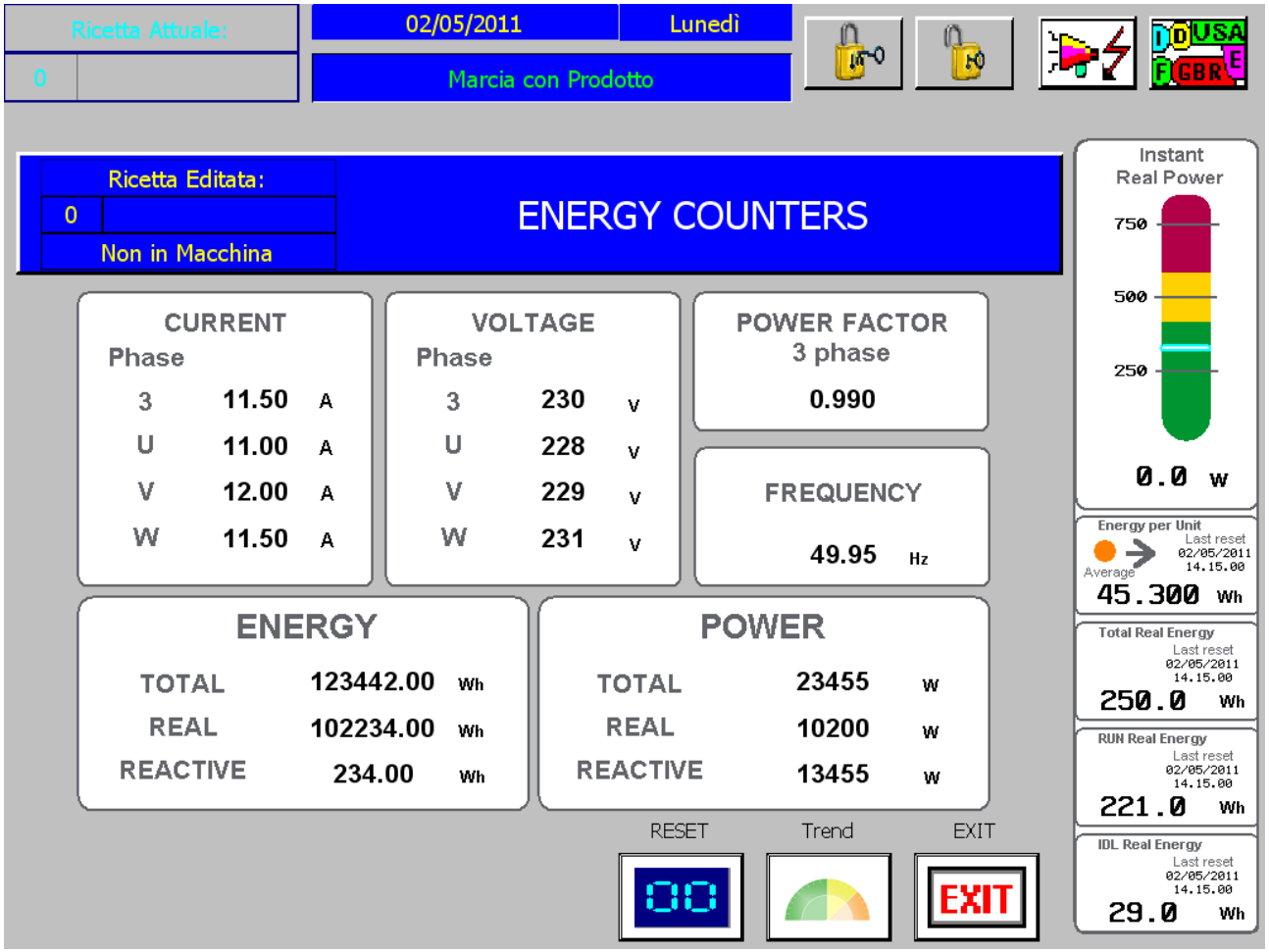




Italy - Packaging Machine: “Energy Bar”



Italy - Packaging Machine: “Energy Bar”



Schneider Electric

A Comprehensive Automation Solution for Industrial Machines

MachineStruxure solutions help machine builders design machines that are optimized for cost, energy efficiency and performance

Reduce Complexity With Machine Struxure

One single software environment	Unique TVDA* value proposition	End-to-end service support	Simple and easy to use

- Integrated software SoMachine:
  Simplify machine programming & commissioning

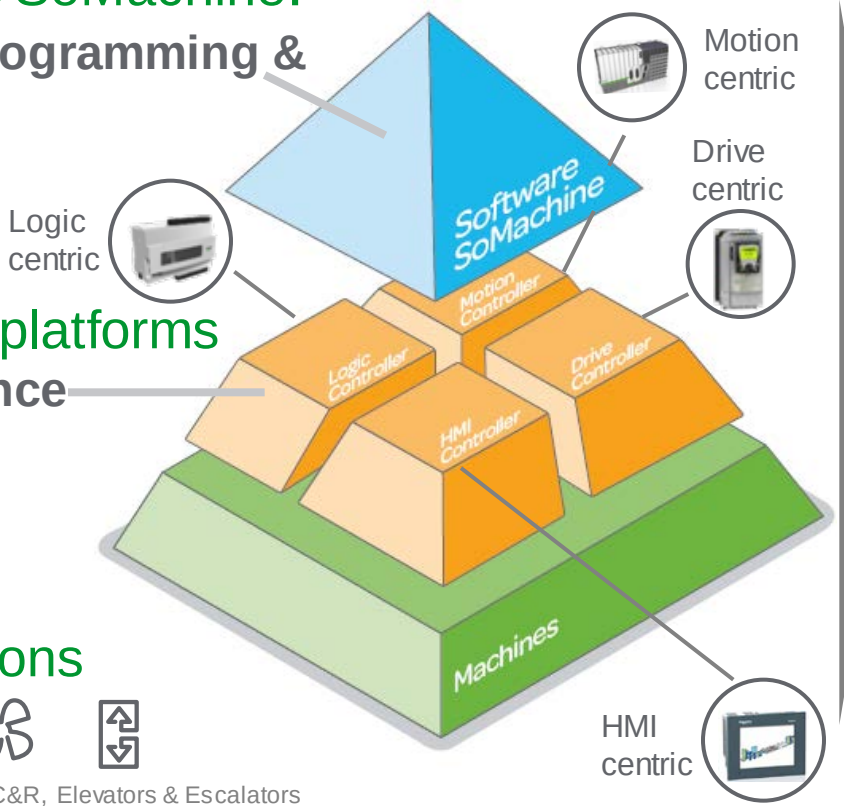
+

- 4 hardware control platforms
  Embedded Intelligence where it is needed

+

- 6 targeted applications

Hoisting, Textile, Packaging, Conveying, HVAC&R, Elevators & Escalators



- Speed up "**concept to design**"
- **Optimize** machine production, flow and capacity
- **Optimize** on-site intervention costs

TVD Architectures

Machine Struxure

- **Tested**
  - Tested in laboratory by experts
  - Ensuring the right functional performance in all possible configurations
- **Validated**
  - Fully functional compatibility of the devices
- **Documented**
  - Complete user guide giving all the details required for installing and building your application with confidence
  - Ready to use with e-plan: predefined CAD panel designs & wiring diagrams

- **Up to 50% control system design time savings**
- **Installation time reduction**

Innovation for Simplicity

Simplified offers

Modicon controllers

Getting closer and being more responsive to local needs

Adapting our offer to meet customer needs

Simplified maintenance

Altivar 32 and Lexium 32 drives

- MMS
- e-mail
- Wap
- Internet

Bluetooth

Send-receive configuration everywhere & any time

Upload-download configuration with drive

Monitor-control drive

Simplified

Self powered wireless push button and Magelis STU

ZigBee

22mm mounting system

Ethernet embedded

Powered by Vijeo Designer

Ensure permanent availability – battery-less

Robustness for harsh environment

Mobile control

Hardware flexibility

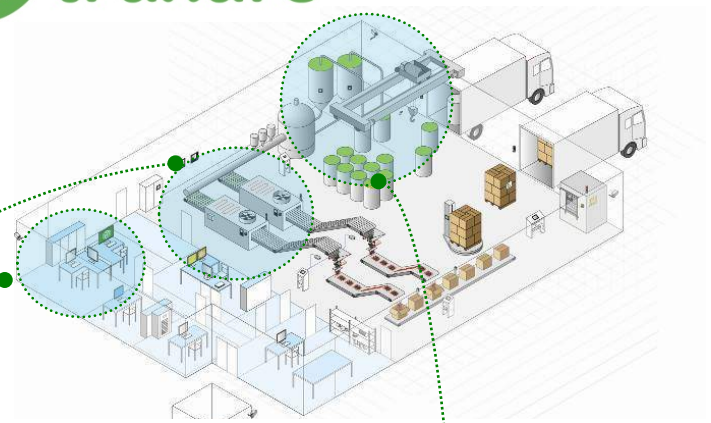
Energy Efficiency

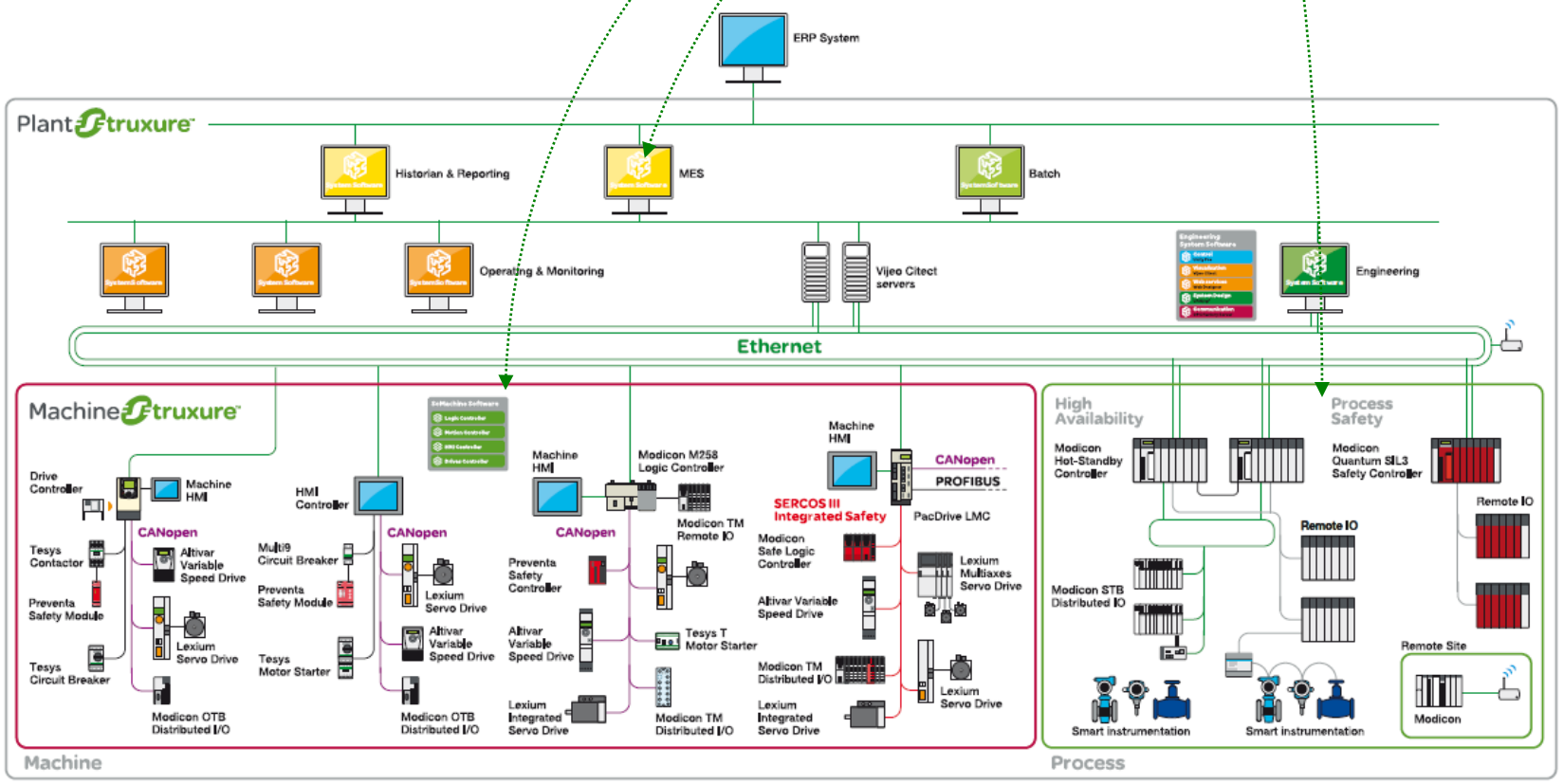
Simplified assembly

Simplified integration

PlantStruxure™ + MachineStruxure

Helps you manage your process more efficiently while using less energy



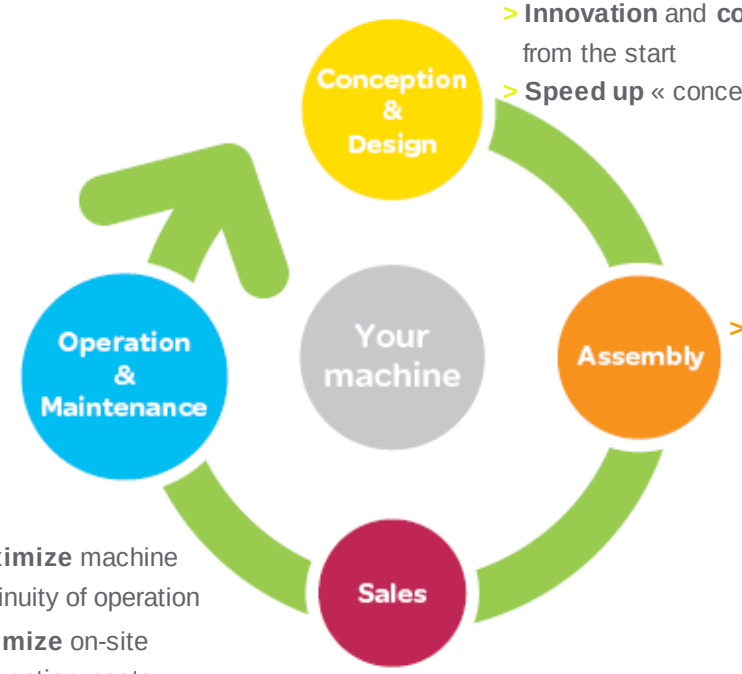


Solutions for Machines

Machine Struxure

Services & support

Throughout the complete machine life cycle



> **Innovation** and **competitiveness** right from the start
> **Speed up** « concept to design »

> **Optimize** machine production flow and capacity

> **Expand** business by addressing new markets
> **Access** international markets while minimizing associated risks

> **Maximize** machine continuity of operation
> **Optimize** on-site intervention costs
> **Generate** profit while keeping end user customer satisfied

> **OEM-specific services and support at every step of your machine life cycle**

> **Improve your end user customers' satisfaction by maximizing their investments**

> **Further develop your sales in a profitable way**

Solutions for Machines

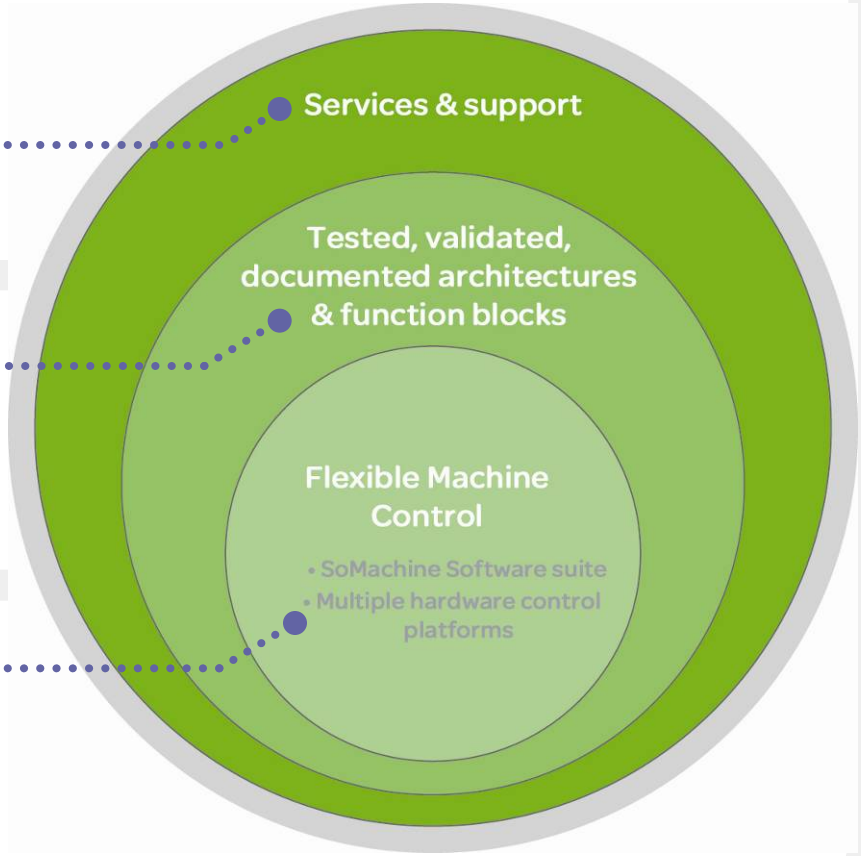
MachineStruxure

With MachineStruxure solutions you can answer your customers' challenges and help them remove complexity from their businesses

Added value throughout the entire life of your machine

Build a strong automation platform through the use of our proven and ready-to-use automation architectures and application function libraries

SoMachine is a single software suite that runs on multiple hardware control platforms to achieve flexible machine control: HMI, motion, drive and logic controllers


Services & support
Tested, validated, documented architectures & function blocks
Flexible Machine Control
• SoMachine Software suite
• Multiple hardware control platforms

Reduce time to market

Save 50% in control design time

100% flexibility & optimization of your machines

Annex

ISO 50001 Standard

Published in June 2011

- ISO 50001 is based on the ISO management system model familiar to more than a million organizations worldwide who implement standards such as:
  - ISO 9001 (quality management), ISO 14001 (environmental management), ISO 22000 (food safety), ISO/IEC 27001 (information security)
- Follows the Plan-Do-Check-Act process for continual improvement of the energy management system
- Provides a framework of requirements enabling organizations to:
  - Develop a policy for more efficient use of energy
  - Fix targets and objectives to meet the policy
  - Use data to better understand and make decisions concerning energy use and consumption
  - Measure the results
  - Review the effectiveness of the policy
  - Continually improve energy management
- ISO 50001 can be implemented individually or integrated with other management system standards

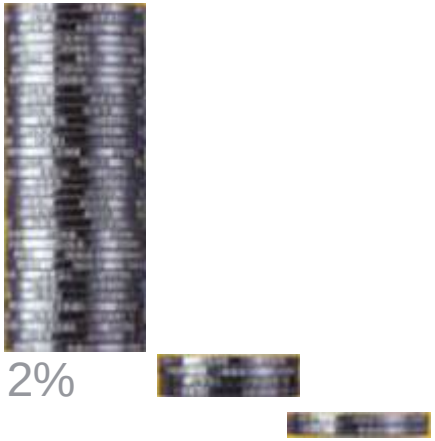
Motor Consumption in the World

Motor's energy bill = motor cost x 100

- in **Industry** **60%** of electricity
- in **Building,** **30%** of electricity

Big Motor:
1 Month
Energy Bill
= Motor Cost

Energy
97%

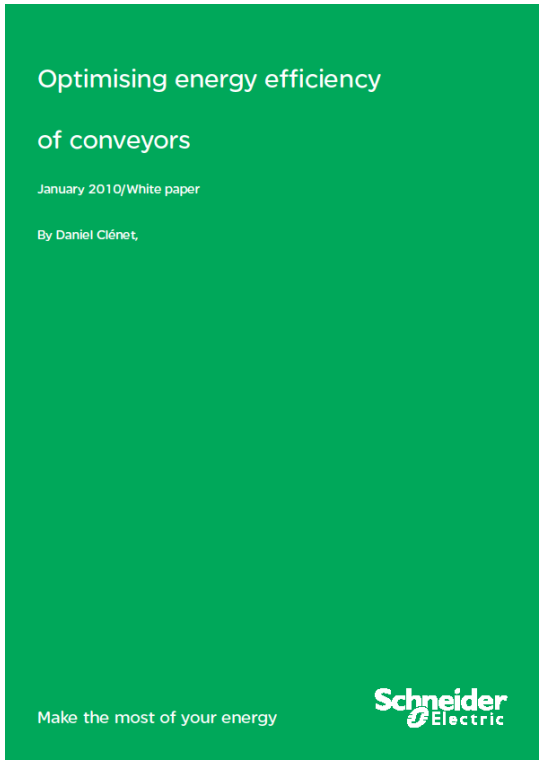


Installation & Maintenance: 2%

Investment: 1%

Global costs during motor life (average 15 years)

Optimizing Energy Efficiency of Conveyors



Packaging: The Right Technology for Energy Efficiency

- Create the Energy Footprint of your machine - simulate and monitor using same software features
- Use High-efficiency servo motors with Lexium SH
- Share DC-bus using using PacDrive iSH and Lexium LXM62 / ILM62 multiaxis solution
- Save cabinet cooling energy by shifting servo drives to the machine frame - integrated servo drives series Lexium ILM
- Optimize flexible machines with ATV32 and brushless motors
- Design energy efficient motion with ECAM
- Design energy efficient path design for robots with PacDrive Robotics library
- Use Intelligent Line Shaft and PacDrive libraries to optimize synchronous servo axes consumption
- Request Schneider Electric Consulting/Engineering for a comprehensive consulting for machine solutions and engineering services support

Hoisting: Active Front End Allows Energy Regeneration

- Active Front End is an option for the frequency inverter to return energy to the mains. It provides 4-quadrant operation and thus it is well qualified for hoisting applications which then generate energy during descent (braking) stages
  - Provides a constant DC voltage supply independent of the load situation.
  - Resistor-less technology
    - Better reliability in harsh environment
    - Huge energy saving
    - Compactness of equipments

- Reduce losses and disturbances in the mains with a THDI < 4%

> More on AFE

PowerLogic System Panorama

Perfect for
Machines
Energy
Monitoring

Advanced energy metering

« PowerLogic » Power Meters

« Acti9 » Energy Meters

Panel instruments

Current Transformers

Thank You!